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Reprint this information in PDF ^{PDF} (*Table 1. Standard Abbreviations and Symbols and Table 2. Abbreviations for units of measurement and physical and chemical quantities not included*)

I Purpose & Scope

The PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES USA (PNAS) publishes research reports, commentaries, perspectives, and colloquium papers. In accordance with the guiding principles established by George Ellery Hale in 1914, PNAS publishes brief first announcements of Academy Members' and Foreign Associates' (hereafter referred to as Members) more important contributions to research and of work that appears to a Member to be of particular importance. PNAS is a general science journal with a broad scientific audience. All papers should be intelligible to this audience.

Research Reports describe the results of original research of exceptional importance.

Commentaries call attention to papers of particular note and are written at the invitation of the Editorial Board.

Perspectives present a viewpoint on an important area of research and are written at the invitation of the Editorial Board.

Colloquium Papers are reports of scientific colloquia held under Academy auspices.

I Editorial Policies

Submission & Review | Journal Policies

Submission & Review

Manuscripts may be submitted to PNAS through any of the following three tracks:

Track I. An Academy Member may "communicate" manuscripts for others that are within the Member's area of expertise. Prior to submission to PNAS, the Member obtains outside reviews of the paper from at least two qualified referees, each from a different institution and not from the authors' institutions.

Track II. Authors (Members or non-Members) may submit their manuscripts directly to the PNAS office. In a cover letter, authors must name up to three Editorial Board Members and five other NAS Members who are expert in the paper's scientific area. The Editorial Board may choose a Member as editor for the paper who is not on that list or may reject the paper without further review. The Member-editor conducts the review of the paper as described for Track I. A list of Members including research interests is on the PNAS Home Page (see NAS Members). Authors may also suggest qualified referees. The name of the Member-editor, who may remain anonymous to the author until the paper is accepted, will be published in PNAS as editor of the article.

Track III. An Academy Member may submit his or her own manuscripts for publication. Members' submissions must be accompanied by the name of knowledgeable colleague(s) who reviewed the paper, along with the review(s).

All Tracks. Manuscripts submitted under any of the three tracks are evaluated by the Editorial Board. The Board may reject manuscripts without further review or may subject manuscripts to review and reject those that do not meet the standards of the journal. Manuscripts rejected by one Member cannot be resubmitted through another Member. When revisions are requested prior to final decision, revised papers must be received within three months or they will be treated as new submissions.

In the journal, Track I, II, and III papers are distinguished respectively as "Communicated by," "Edited by," and "Contributed by" the responsible Member. Track II papers have an additional identifying footnote.

Journal Policies

(i) Articles are accepted provided they have not been PUBLISHED PREVIOUSLY or concurrently submitted for publication elsewhere. Three copies of any closely manuscripts in press or submitted for publication elsewhere by the authors must be included.

Figures or tables that have been published elsewhere must be identified, and permission of the copyright holder for *both* the print and the online editions of the journal must be provided.

(ii) AUTHORSHIP should be limited to those who have contributed substantially to the work. The corresponding author must have obtained permission from all authors for the submission of each version of the paper and for any change in authorship.

(iii) All authors and Members must disclose any association that poses a CONFLICT OF INTEREST in connection with the manuscript. All funding sources supporting the work must be acknowledged.

(iv) A completed form assigning COPYRIGHT to the National Academy of Sciences must be returned to the PNAS office before the paper can be published. This and other forms are available in the back of each issue and at www.pnas.org/misc/forms.shtml.

(v) The Academy may distribute EMBARGOED copies of an article to the press prior

to publication.

(vi) Research involving HUMAN AND ANIMAL SUBJECTS must have been approved by the author's institutional review board. All clinical investigation must have been conducted according to the principles expressed in the Declaration of Helsinki.

(vii) For research using RECOMBINANT DNA, physical and biological containment must conform to National Institutes of Health guidelines or those of a corresponding agency.

(viii) Authors must make UNIQUE MATERIALS (e.g., cloned DNAs; ~~antibodies~~; bacterial, animal, or plant cells; viruses; and computer programs) promptly available on request by qualified researchers for their own use. Failure to comply will preclude future publication in the journal. Contact the Editor-in-Chief if you have difficulty obtaining materials.

(ix) DATABASES Accession codes must be supplied for publication. A footnote indicating that the data have been deposited will be added to the paper.

Protein and Nucleic Acid Sequences. Authors should submit manuscripts containing nucleotide sequences to:

GenBank/EMBL/DNA Data Bank of Japan (DDBJ) at GenBank
National Center for Biotechnology Information
8600 Rockville Pike, Building 38A, Room 8N-803, Bethesda, MD 20894 USA
Phone 1-301-496-2475
E-mail (submissions) gb-sub@ncbi.nlm.nih.gov
E-mail (information) info@ncbi.nlm.nih.gov

An accession number must be obtained before the manuscript is published.

Structures of Oligonucleotides. Authors must deposit these data directly with the Nucleic Acid Database or its equivalent at deposit@ndbserver.rutgers.edu.

Structural Studies. Authors of papers describing new structure determinations must submit to the Protein Data Bank at the Research Collaboratory for Structural Bioinformatics or its equivalent, all structural data required to validate the discussion, including x-ray amplitudes and the derived atomic coordinates. For nuclear magnetic resonance structures, data deposited should include resonance assignments and all restraints used in structure determination and the derived atomic coordinates for both an individual structure and a family of acceptable structures. Articles must include literature references for all coordinate datasets as well as dataset identification. Authors must agree to release the coordinates when the article is published.

Functional Magnetic Resonance Imaging (fMRI) Studies. Authors should deposit these data directly with the fMRI Data Center at www.fmridc.org.

(x) SUPPORTING INFORMATION: Supporting Information provides a way to enhance papers in PNAS by providing additional substantive material. Supporting Information is reviewed along with the paper but instead of appearing in the printed version of the journal, is distributed via the PNAS web site at the time of publication. Supporting Information is referred to at the appropriate point in the text and cannot be altered by authors after papers have been accepted.

Supporting Information may take the form of supplemental figures, tables, derivations, and videos. Authors should express their interest in their cover letter to include Supporting Information with their paper. In addition, editors may suggest that part of the submitted data could be more suitably presented online only to save journal space and to focus the article. (Details available on request from pnas@nas.edu.)

(xi) PNAS EARLY EDITION: As of January 2000, PNAS articles are published online before print at www.pnas.org in PNAS Early Edition. Papers are published online 1 to 5 weeks before they appear in print. Authors who return proofs quickly and keep changes to a minimum get maximum publication speed. The date a paper appears online in PNAS Early Edition is the publication date of record and is posted with the article text online.

Procedures for Submitting Manuscripts

Contact Information | Publication Charges | Manuscript Preparation | Manuscript Length | Manuscript Format

Contact Information

Authors are encouraged to submit via the web (see below). If submitting in print, send five complete copies (six for Track II submissions) of the final manuscript with referee-quality figures and PNAS forms (including character count breakdown) to:

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, 2001 Wisconsin Avenue, NW, Washington, DC 20007 USA

or by courier or express mail to:

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, 1055 Thomas Jefferson Street, NW, Suite 2013, Washington, DC 20007 USA

Phone 1-202-334-2679 or -2672, fax 1-202-334-2739, e-mail pnas@nas.edu.

Publication Charges

Page charges. PNAS depends, in part, on the payment of page charges for its operation. Payment of the page charge of \$60 per printed page is requested from all authors who have funds available for that purpose. Payment of \$100 per article is also requested for Supporting Information for the web. Articles are accepted or rejected for publication and published solely on the basis of merit.

Color charges. Payment by authors of the following additional costs is expected: \$500 for each color illustration; \$150 for each replacement or deletion of a color figure; \$200 for Color Supporting Information that must be scanned. A single figure is defined as original art that can be processed as a unit and printed on one page without intervening type. Requests for waiver of color charges should be submitted to the Editor-in-Chief.

Manuscript Preparation

Submitting Online Manuscripts. Authors are encouraged to submit Adobe Acrobat PDFs of their papers via the web at www.pnas.org/submit. Supporting Information for the web may also be submitted online. Online submission expedites the submission and review process and reduces the cost and delay of photocopying and mailing. The PNAS sizing worksheet also appears online as an interactive form to aid

in calculating the character count.

Submitting Print Manuscripts.

- **Text on Disk.** Manuscripts must be accompanied by a computer disk containing the final text. The version on the disk must match the hard copy. Guidelines for papers submitted in TeX or LaTeX are at www.pnas.org/misc/texdoc.pdf.
- **Figures.** Original drawings, high-quality photographs, or laser prints are required (halftones should be high-quality originals or photographs). Submit figures at the desired printed size, preferably 1 column width (8.7 cm) or the smallest size that will convey the essential scientific information. Figures wider than 1 column should be between 10.5 and 18.0 cm wide. If submission at final size is not feasible, indicate the reduction and include one photocopy of each figure at the final size. Numbers, letters, and symbols should be at least 2 mm in size after reduction and must be consistent. Composite figures should be preassembled. For color figures, submit one set of prints for the printer (unmounted or mounted on flexible backing) at final size (preferably 1 column width), or slides with a print or a color photocopy indicating magnification and cropping, and four sets of high-quality prints. Label the back of each figure with the first author's name, the figure number, the orientation (top), and the desired final size. Return of figures cannot be guaranteed.
- **Digital Figures.** Digital figures must be on a *separate disk* from the manuscript and accompanied by camera-ready originals or high-quality laser proofs suitable for scanning. Label the disk with the file name, type, and size. Indicate the input resolution on any scanned images, the format of any compressed files, and the file format--TIFF and EPS formats for Macintosh or PC are the only acceptable formats. All color images must be in CMYK (cyan, magenta, yellow, black) mode. Include the font files for any text. PC or Macintosh versions of Adobe PostScript fonts must be used (no system "bitmap" fonts). Images must be final size, preferably 1 column (8.7 cm) width. Figures wider than 1 column should be between 10.5 and 18.0 cm wide. Composite figures must be preassembled. Details and the Digital Art Submission Checklist are at cjs.cadmus.com/da.
- **Journal Cover Figures.** PNAS considers cover illustrations relevant to an article in an issue. Submissions must be scientifically interesting and visually arresting. Illustrations need not be reprinted in the article, but should be representative of the work. Submit two glossy prints 20 cm wide by 12 cm high with the top indicated and include a brief lay-language caption (50-60 words). Digital art may accompany prints (see below). Label the submission with the first author's name and the corresponding author's name, address, phone and fax numbers, and e-mail address. Direct submissions to the PNAS office. Illustrations will not be returned unless requested.
- **Tables.** Number tables (Arabic numerals) in the order in which they are cited in the text. Each table should have a brief title, be on a separate page, and be printed double-spaced.
- **Supporting Information.** Supporting Information should be saved, preferably in HTML, JPEG, GIF, or PDF, on *separate* floppy disks, clearly marked "Supporting Information for the Web" with the title, corresponding author's name, file names, and name and version of programs used to create the files. Five paper copies of Supporting Information should also be supplied, similarly marked. Refer to Supporting Information in the manuscript at an appropriate point in the text or figure/table legend.

Use the file formats listed below for Supporting Information only. Provide a brief description of each item in a *separate* HTML file (i.e., figure or table legends, captions for movie or sound clips, etc.). Do not save figure numbers, legends, or author names as part of an image. File sizes should not exceed 5 MB. Images should not exceed 500 pixels per inch in width or height. Excel tables should be tab-delimited. Do not use tabs or spaces for Word or WordPerfect tables. Submit one still image for each movie clip. For web provide a complete list of files and instructions for creating directories.

- .htm, HTML*
- .jpg, JPEG image*
- .gif, Graphical image*
- .pdf, PostScript
- .xls, MS Excel spreadsheet
- .mov, Quick Time
- .wav, Sound
- .doc, MS Word 6 document†
- .txt, Plain ASCII*

*These files can be viewed directly on standard web browsers.

†Use MS Word for text only.

Print Submission Checklist

- ☐ Five complete copies (six for Track II submissions) of the manuscript in final form, double-spaced, pages numbered.
- ☐ One set of figures for the printer, four sets of high-quality figures, and one photocopied set of figures.
- ☐ The final version of the text and any digital art and Supporting Information for the Web, each on separate computer disks. Identify the platform, program, first author, date, and file name on the disk label.
- ☐ The completed Copyright Assignment/Documentation Report Form.
- ☐ The Character Count Breakdown of the final manuscript.
- ☐ Disclosure of associations that pose a conflict of interest, and acknowledgment of all funding sources.
- ☐ The classification of the paper.
- ☐ References according to PNAS style.

Manuscript Length

PNAS generally uses a two-column format averaging 60 characters, including spaces, per line. The maximum length of a research article is six printed pages or 47,000 characters, including all text, spaces, and the number of characters displaced by figures, tables, and equations. The total number of characters equals:

- The number of characters *including* spaces in the text (include all parts except tables), **plus**
- The height in cm of each figure at desired printed size x 180 for a one-column figure or x 360 for a two-column figure, **plus**
- The height in number of lines of each table x 60 for a one-column table or x 120 for a two-column table, **plus**
- A 120-character allowance for the space above and below each single column of a figure, table, or equation, **plus**
- An additional 60 characters for each one-column line of equation.
- A table that has lines with more than 60 characters plus spaces or a figure that is wider than 8.7 cm takes up *two* columns in width.

If the word processing program character count *excludes* spaces, add the word count to the character count to obtain a character count that includes spaces.

Authors will be responsible for additional charges incurred due to shortening overlong papers in proof.

Sample Character Count (Provide Breakdown with Manuscript)

Material	Character count
All text characters (including title page, abstract, legends, references) <i>plus</i> spaces	25,660
Fig. 1 (1-column, 16 cm high = 180 x 16)	2,880
Fig. 2 (1-column, 12 cm high = 180 x 12)	2,160
Fig. 3 (1-column, 21 cm high = 180 x 21)	3,780
Fig. 4 (1-column, 11 cm high = 180 x 11)	1,980
Fig. 5 (2-column, 17 cm high = 360 x 17)	6,120
Table 1 (2-column, 23 lines high = 120 x 23)	2,760
Equations [one 2-line and one 1-line eq., 1-col. = (3 x 60)]	180
Space Allowance	
4 single-column figures (4 x 120)	480
1 double-column figure (1 x 240)	240
1 double-column table (1 x 240)	240
2 single-column equations (2 x 120)	240
Total characters in paper (must not exceed 47,000)	46,720

Manuscript Format

General Format | Nomenclature & Style | Abbreviations and Symbols

General Format

Title Page. Include the following information on this page.

- **Classification:** Select a major (Physical, Biological, or Social Sciences) and a minor category from the following. Dual classifications are permitted *between* major categories and in exceptional cases, subject to Editorial Board approval, *within* a major category.
 - *Physical Sciences:* Applied Mathematics, Applied Physical Sciences, Astronomy, Chemistry, Computer Sciences, Engineering, Geology, Geophysics, Mathematics, Physics, and Statistics.
 - *Biological Sciences:* Agricultural Sciences, Anthropology, Applied Biological Sciences, Biochemistry, Biophysics, Cell Biology, Developmental Biology, Ecology, Evolution, Genetics, Immunology, Medical Sciences, Microbiology, Neurobiology, Pharmacology, Physiology, Plant Biology, Population Biology, and Psychology.
 - *Social Sciences:* Anthropology, Economic Sciences, Psychology, Political Sciences, and Social Sciences.
- **Title:** Should not include nonstandard abbreviations and must be brief.
- **Author affiliation:** Include department, institution, and complete address for each author. If there are authors with different affiliations, use superscripts to match authors with institutions.
- **Corresponding author:** The name, complete address, telephone and fax numbers, and e-mail address of the author to whom correspondence and proofs should be sent. Mailing and e-mail addresses will appear in print and

online.

- **Manuscript information:** The number of text pages (including references and figure legends), of figures, and of tables.
- **Word and character counts:** The number of words in the abstract and the total number of characters in the paper.
- **Abbreviations footnote:** List nonstandard abbreviations used five or more times. Define these where first mentioned in the text and do not use them in the title.
- **Data deposition footnote:** Supply all database accession numbers and/or codes.

Abstract. Provide an abstract of no more than 250 words on page 2 of the manuscript. Abstracts should explain to the general reader the major contributions of the article. References in the abstract must be cited in full.

Text. Describe procedures in sufficient detail so that the work can be repeated. Methods should be presented before Results and Discussion. Follow the spelling and usage given in *Webster's Third New International Dictionary* or the *Random House Dictionary of the English Language*. Avoid laboratory jargon. Correct chemical names should be given and strains of organisms should be specified. Trade names should be identified by an initial capital letter with the remainder of the name lowercase. Names and addresses of suppliers of uncommon reagents or instruments should be provided. Use Système International (SI) units and symbols whenever possible. When SI units are not used, the factor for conversion should be provided on first usage.

Footnotes. Use symbols in the order *, †, ‡, §, ¶, ||, **, ††, ‡‡, §§, ¶¶.

Acknowledgments. List dedications, acknowledgments, and funding sources.

References. References must be in PNAS style. Only published or in-press papers and books may be cited in the reference list. Abstracts of papers presented at meetings are not permitted. References should be cited in numerical order as they appear in text. Because tables and figures will be inserted in the text where first cited, references in these sections should be numbered accordingly. All authors (unless there are 10 or more) should be named in the citation. Databases are cited in the text or as footnotes.

The corresponding author must be prepared to provide a signed authorization for the citation of unpublished data and personal communications.

Journal articles are cited as follows:

10. Neuhaus, J.-M., Sitcher, L., Meins, F., Jr., & Boller, T. (1991) *Proc. Natl. Acad. Sci. USA* **88**, 10362-10366.

For correct abbreviations of journal titles, refer to *Chemical Abstracts Service Source Index* (CASSI).

Articles or chapters in books are cited as follows:

14. Hill, A. V. S. (1991) in *Molecular Evolution of the Major Histocompatibility Complex*, eds. Klein, J. & Klein, D. (Springer, Heidelberg), pp. 403-420.

Figure Legends. Provide these separately from figures.

Nomenclature & Style

International standards on nomenclature should be used. The following guides are recommended for papers published in PNAS:

- **General:** *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers*, 6th Ed. (1994). Council of Biology Editors, 11250 Roger Bacon Drive, Suite 8, Reston, VA 20190-5202.
- **Chemistry:** *The ACS Style Guide: A Manual for Authors and Editors*, 2nd Ed., ed. Dodd, J. S. (1997). American Chemical Society Publications, 1155 16th Street, N.W., Washington, DC 20036.
- **Genetics:**
 - *Bacterial*. Demerec, M., Adelberg, E. A., Clark, A. J. & Hartman, P. E. (1966) *Genetics* **54**, 61-76.
 - *Human*. Approved human gene symbols should be obtained prior to submission from Dr. Sue Povey, HUGO Gene Nomenclature Committee, University College London, Wolfson House, 4 Stephenson Way, London, NW1 2HE, UK. E-mail nome@galton.ucl.ac.uk, phone 44-20-7679-7410, fax 44-20-7387-3496. Nomenclature guidelines are available, and the Gene Name Proposal form may be completed on the web page. See also White *et al.* (1997) *Genomics* (1997) **45**, 468-471.
 - *Mouse*. Approved mouse nomenclature should be obtained prior to submission from Lois Maltais, The Jackson Laboratory, Bar Harbor, ME 04609-0800. E-mail nomen@informatics.jax.org, phone 207-288-6429, fax 207-288-6132, International Committee on Standardized Genetic Nomenclature for Mice.
 - *Plant*. Commission on Plant Gene Nomenclature (1994) *Plant Mol. Biol. Rep.* **12**, Suppl. 2.
 - *Other*. O'Brien, S. J., ed. (1993) *Genetic Maps: Locus Maps of Complex Genomes* (Cold Spring Harbor Lab. Press, Plainview, NY), 6th Ed.
- **Immunology:** For human immunoglobulins and their genetic factors, the rules of the World Health Organization or the first reference book for *Life Sciences* below should be used.
- **Life Sciences:** *Biochemical Nomenclature and Related Documents* (1992) 2nd Ed. (a compendium of IUPAC-IUBMB documents, all of which have appeared elsewhere) Portland Press Ltd., 59 Portland Place, London W1N 3AJ, U.K., on behalf of the International Union of Biochemistry and Molecular Biology (in North America, Portland Press, Inc., P.O. Box 2191, Chapel Hill, NC 27515-2191). This compendium contains the International Union of Biochemistry rules of nomenclature for amino acids, peptides, nucleic acids, polynucleotides, vitamins, coenzymes, quinones, folic acid and related compounds, corrinoids, lipids, enzymes, proteins, cyclitols, steroids, carbohydrates, carotenoids, peptide hormones, and human immunoglobulins.

Enzymes should be identified by the recommended name followed in parentheses by the systematic name and the Enzyme Commission (EC) number on first mention, in both the abstract and the text. For guidance refer to: *Enzyme Nomenclature* 1992 (1992) Academic Press, Orlando, with Supplement 1 (1993), Supplement 2 (1994), Supplement 3 (1995) and Supplement 4 (1997) (in *Eur. J. Biochem.* (1994) **223**, 1-5; *Eur. J. Biochem.* (1995) **232**, 1-6, *Eur. J. Biochem.* (1996) **237**, 1-5, and *Eur. J. Biochem.* (1997) **250**, 1-6, respectively).

- **Mathematics:** *A Manual for Authors of Mathematical Papers* (1970)

[reprinted with corrections (1980)] American Mathematical Society, 321 South Main Street, P.O. Box 6248, Providence, RI 02904.

- **Physics:** *AIP Style Manual* (1990) American Institute of Physics, 335 East 45th Street, New York, NY 10017.
- **Psychology:** *Publication Manual of the American Psychological Association* (1994) 4th Ed. American Psychological Association, 750 First Street, N.E., Washington, DC 20002-4242.

Abbreviations and Symbols

PNAS distinguishes between standard and nonstandard abbreviations and symbols. "Standard" includes the symbols for the chemical elements; the three-letter codes for the amino acids, carbohydrates, lipids, and nucleotides; the two-letter codes for chemical radicals; and the units of the Système International (*Table 1. Standard Abbreviations and Symbols* and *Table 2. Abbreviations for units of measurement and physical and chemical quantities*). Most other abbreviations are considered to be nonstandard, should be kept to a minimum, and must be spelled out on first usage in both abstract and text. Nonstandard abbreviations should be used only for terms mentioned five or more times in the paper (see Title Page) and should be unambiguous. Authors should refer to *Quantities, Units and Symbols in Physical Chemistry* (1993) 2nd Ed. Blackwell Science, Oxford; or *National Institute of Standards and Technology Special Publication 330* (1991) 6th Ed. U.S. Government Printing Office, Washington, DC 20402.

The use of too many abbreviations, symbols, and acronyms makes a paper difficult to read. Therefore, these short forms should be used with care. It is best to abbreviate units of measure after numerals to allow extra emphasis to the numeral. Very common terms sometimes are more easily recognized in this short form--e.g., DNA, ATP--and therefore these forms are preferred. However, PNAS is a multidisciplinary journal and short forms common in one field may not be recognized by all readers.

Reprint this information in PDF ^{PDF} (*Table 1. Standard Abbreviations and Symbols* and *Table 2. Abbreviations for units of measurement and physical and chemical quantities not included*)

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